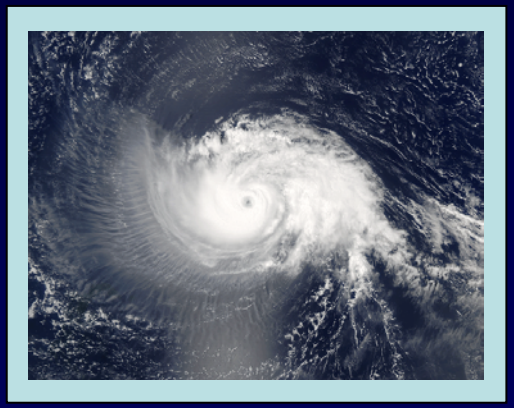
Hurricane Isabel Related Deaths - Virginia's Experience and Response, 2003



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CDC
Centers for Disease Control and Prevention

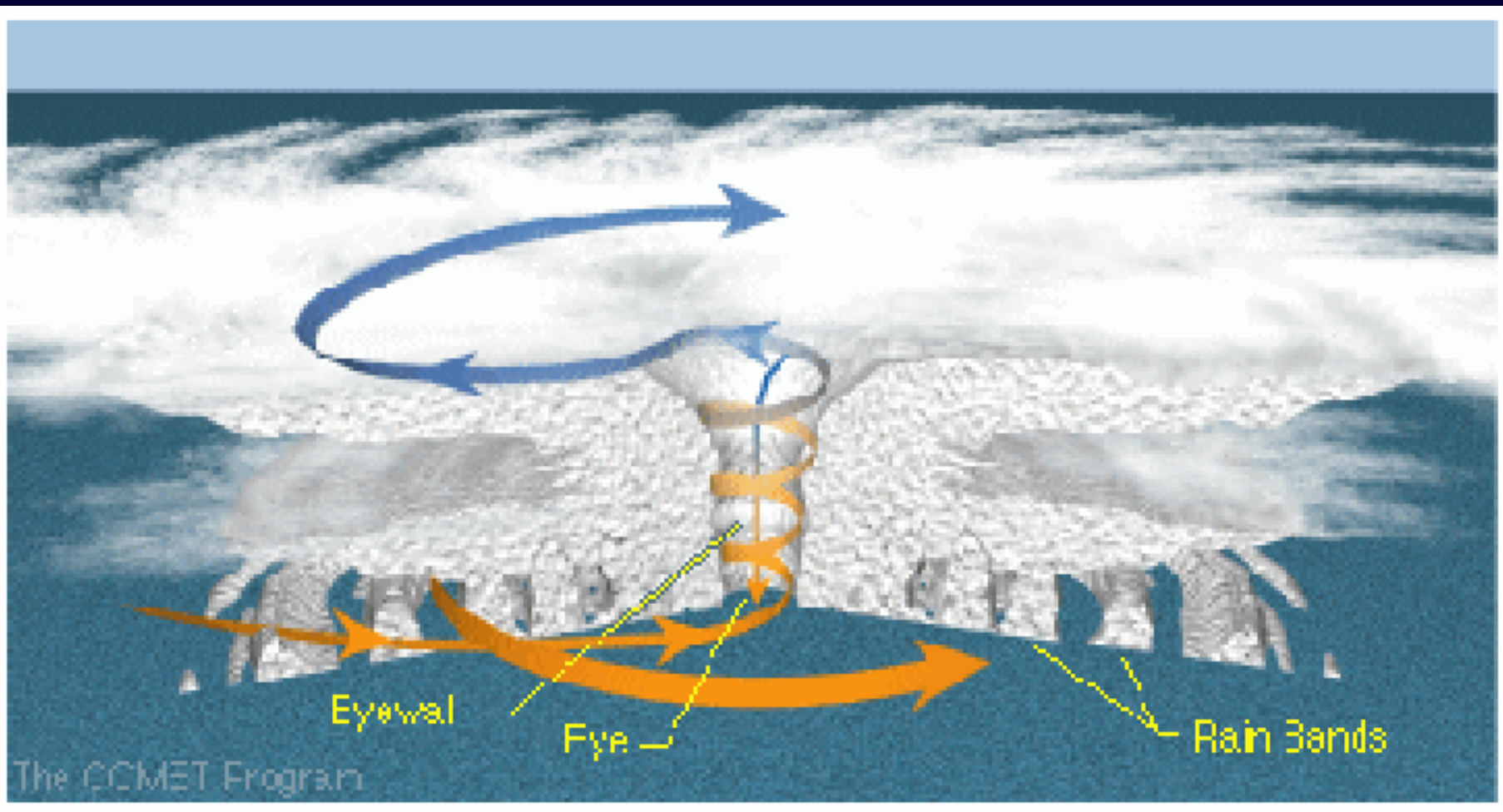
VDH Virginia Department of Health
Protecting You and Your Environment

Outline

- History and overview of the public health impact of hurricanes
- Epidemiologic analysis of Hurricane Isabel related mortality
  - Descriptive epidemiology
  - Quantification of the impact on mortality
- Important post-Isabel assessment efforts and recommendations

Hurricanes

- Hurricane damage induced by storm surge, flooding, high winds, landslides, tornadoes
- US hurricane history
  - Galveston – 1900 (deadliest); > 8,000 people died
  - Andrew – 1992 (costliest); $26 billion in damages


Eyewal
Eye
Rain Bands
The COMET Program

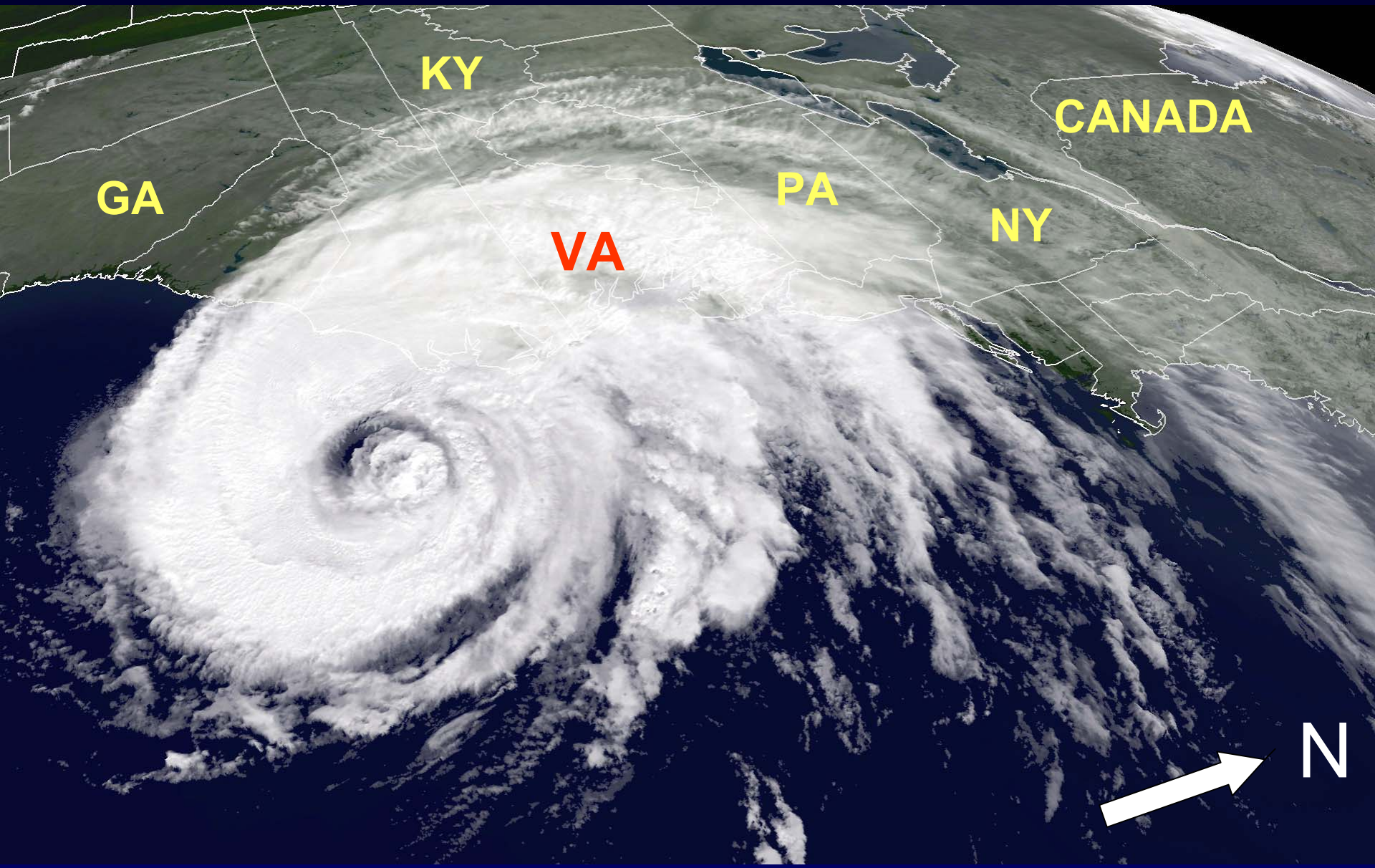
Hurricanes

Saffir-Simpson scale

Scale	Wind Speeds (mi/hr)	Storm Surge (Feet)
1	74-95	4-5
2	96-110	6-8
3	111-130	9-12
4	131-155	13-18
5	> 155	> 18

Hurricanes - Virginia

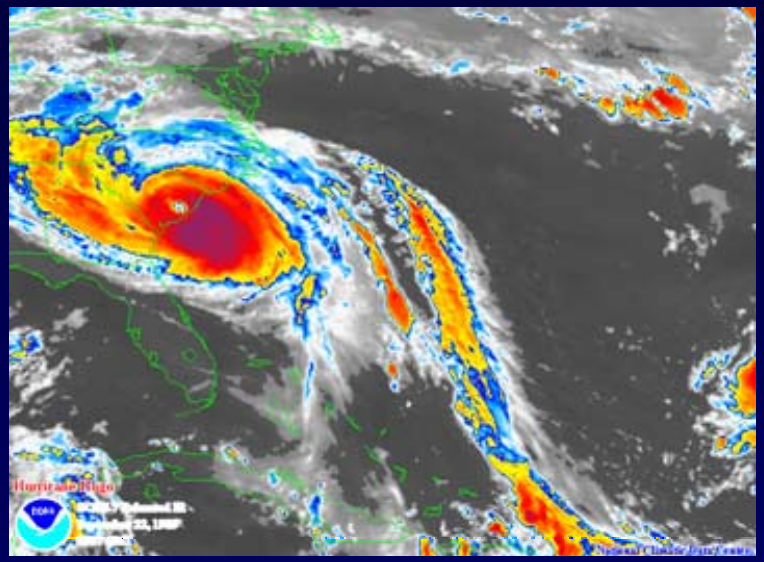
- Deadliest – Camille (1969) – category 5
  - 113 deaths due to flash floods and landslides
  - 8,931 injured; 5,662 homes destroyed
- Unique geographic characteristics:
  - Cold dry air wrapping around storms increases risk of tornadoes
  - Blue Ridge Mountains create an upward air flow and flash flooding / landslides can occur

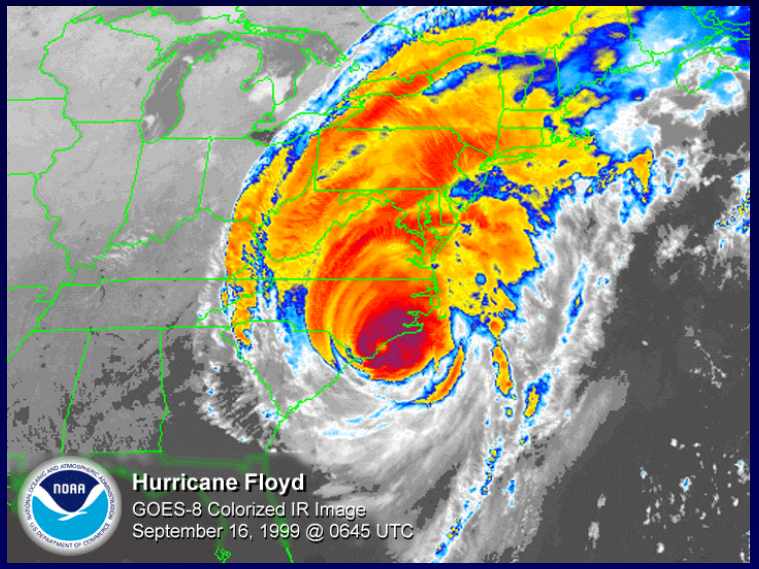


(NOAA satellite image making landfall taken Sept. 18, 2003)

Contextual History

Cape Verde Hurricanes





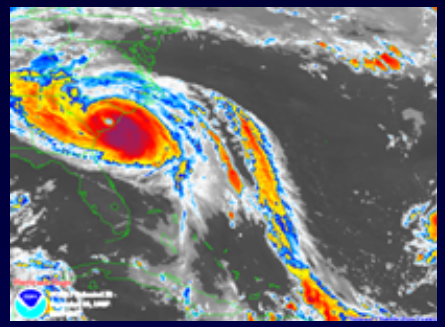
Hugo - 9/22/89

“windmaker”

Floyd - 9/16/99

“rainmaker”

Contextual History



Hugo - 9/22/89

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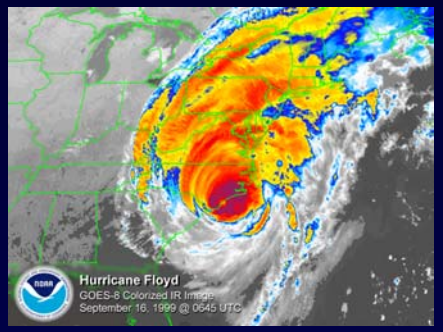

Floyd - 9/16/99

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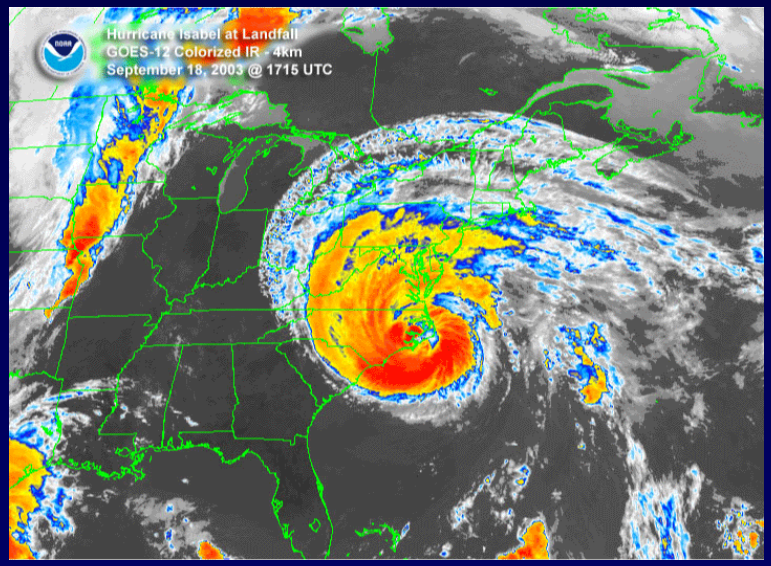


Isabel - 9/18/03

"'mixed ?"

Public Health Impact - Virginia

- Effect on the Commonwealth
  - $1.6 billion in property damage
  - > 1,000 homes & 800 businesses destroyed
  - 1.8 million electricity customers without power
  - Extensive tree damage


DANGER DO NOT ENTER

Epidemiologic Analysis

- To describe the basic epidemiologic features of the Hurricane Isabel related deaths in Virginia
- To quantify the impact of the hurricane on the death rates due to unintentional injuries compared to prior years

Data Sources and Methods

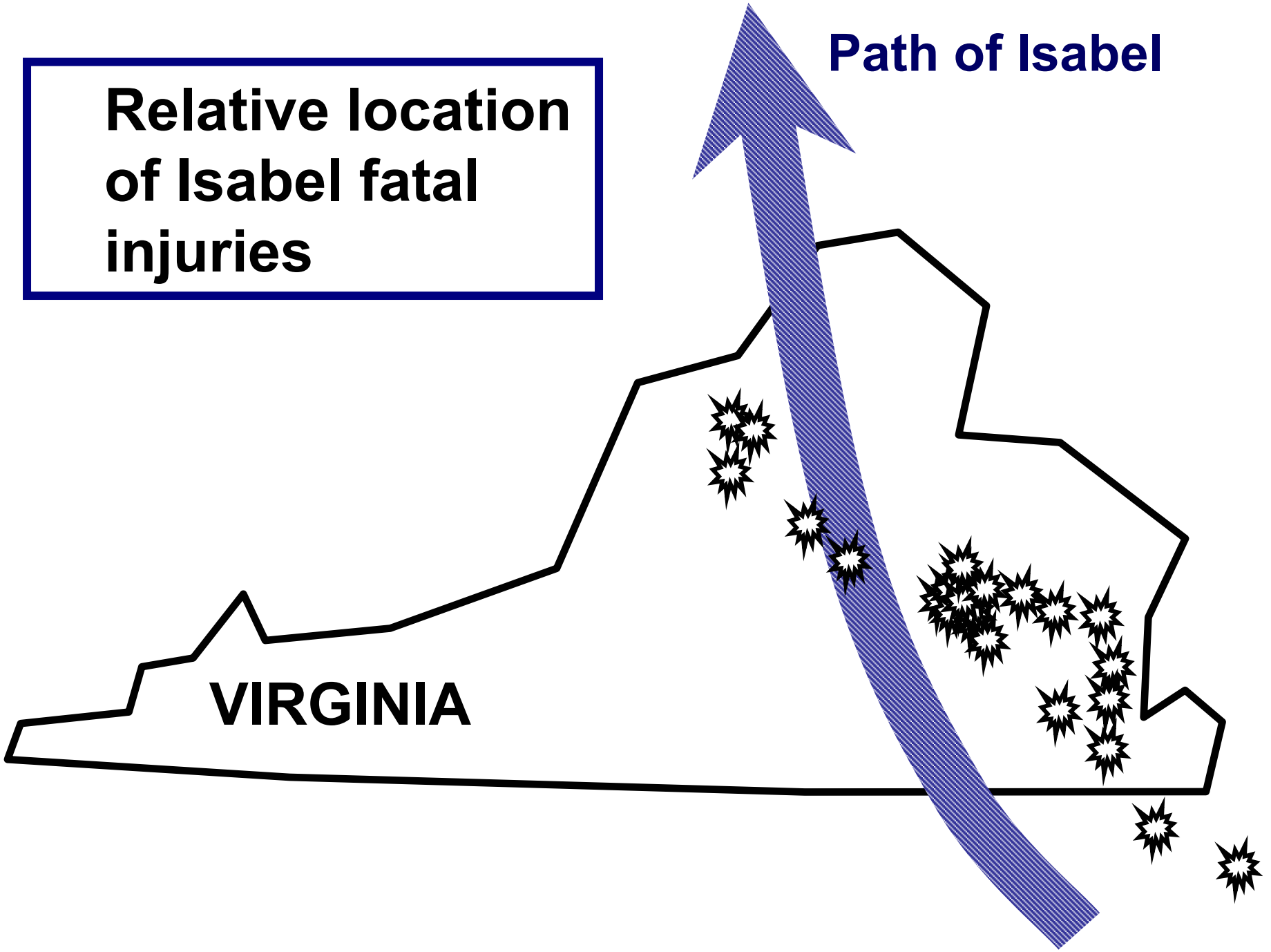
- **Data sources**
  - Medical Examiner reports and records
  - Vital Statistics office - Center for Health Statistics
  - Official reports for assessment and response
- **Methods**
  - Data analysis - Epi Info 2002
  - Proportional mortality and attributable risk percent (unintentional injury related death data – 2000 to 2003)

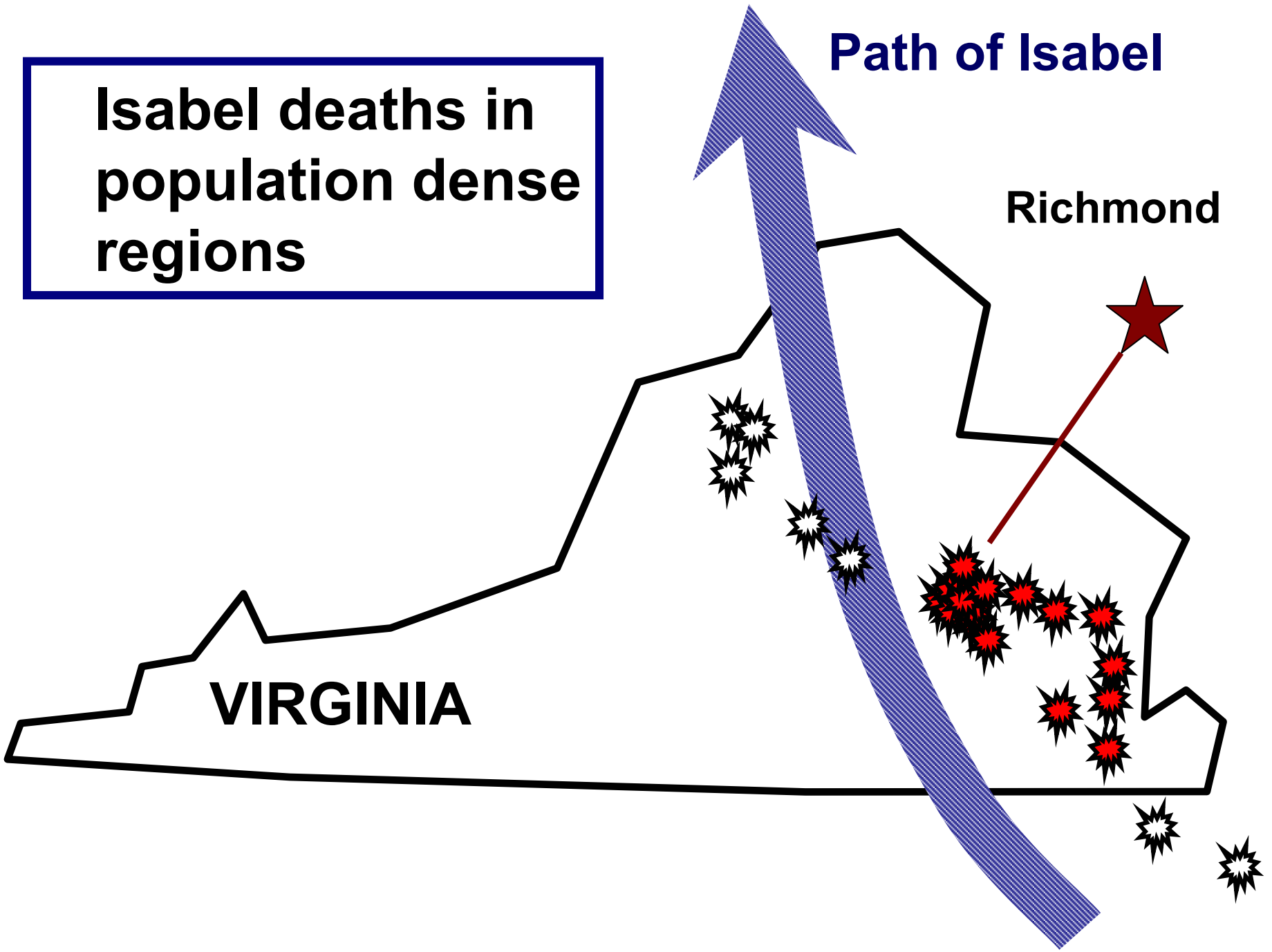
Case Definitions for Weather Related Deaths

- **Criteria:**
  - Associated with Hurricane Isabel (medical examiner assessment)
  - Virginia – location of death
  - Consensus – medical examiner & National Hurricane Center
  - Classification of direct vs. indirect – (published criteria)

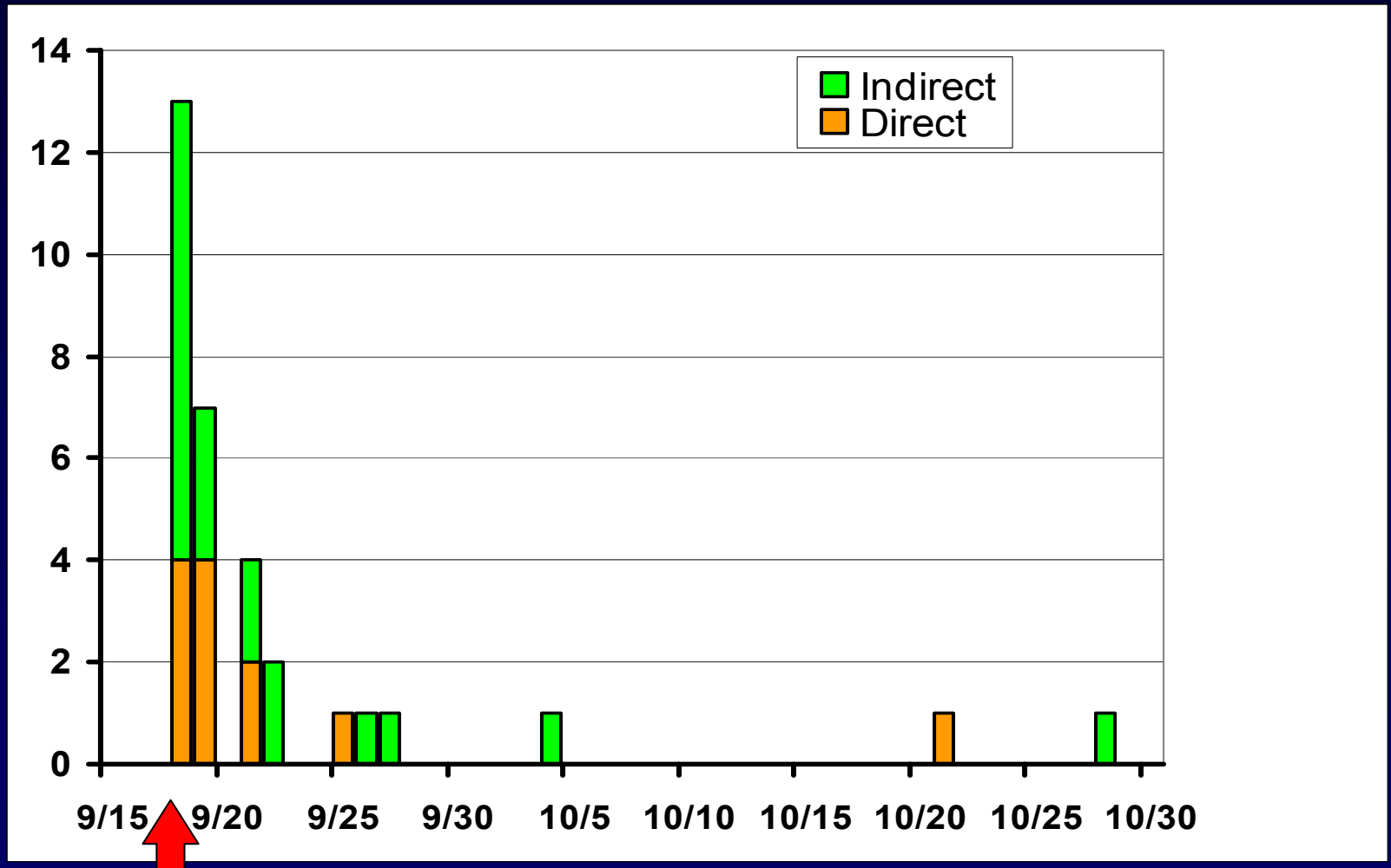
Descriptive Epidemiology

- How did Isabel's path affect injury location?
- Where did the fatal injuries occur?
- When did the deaths occur relative to the passage of the hurricane?
- How were deaths classified?
- What were the causes of death?
- What demographic characteristics were of importance?


Relative location of Isabel fatal injuries
Path of Isabel
VIRGINIA


Isabel deaths in population dense regions
Path of Isabel
Richmond
VIRGINIA

Number of Decedents by Date and Classification of Death



# of deaths

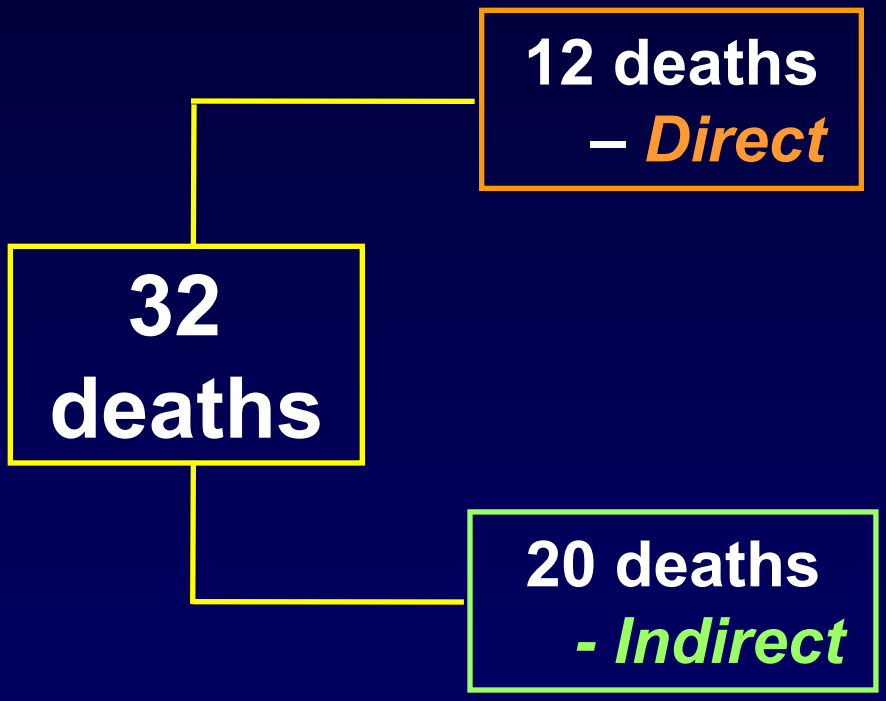
Date of death

Classification of Hurricane Deaths

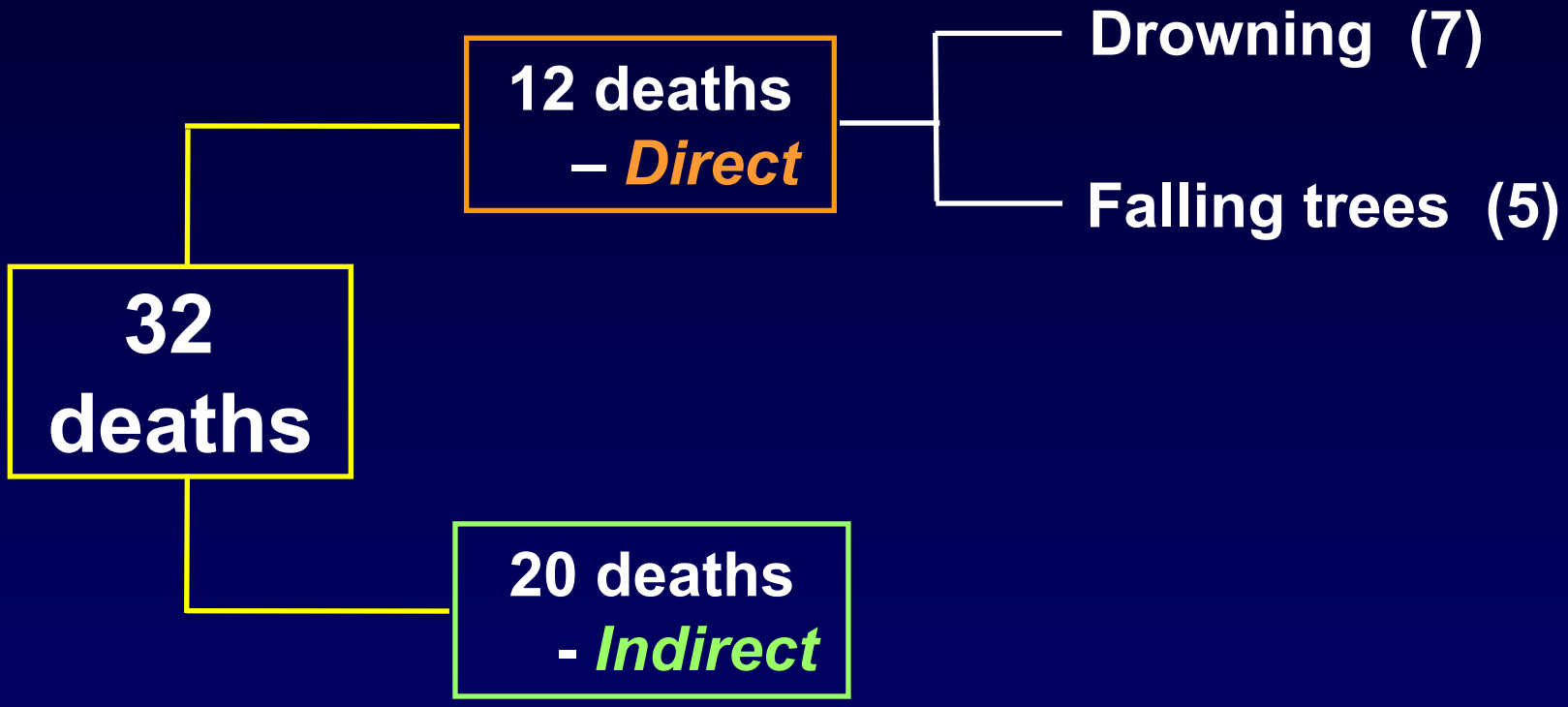
32
deaths

Classification of Hurricane Deaths

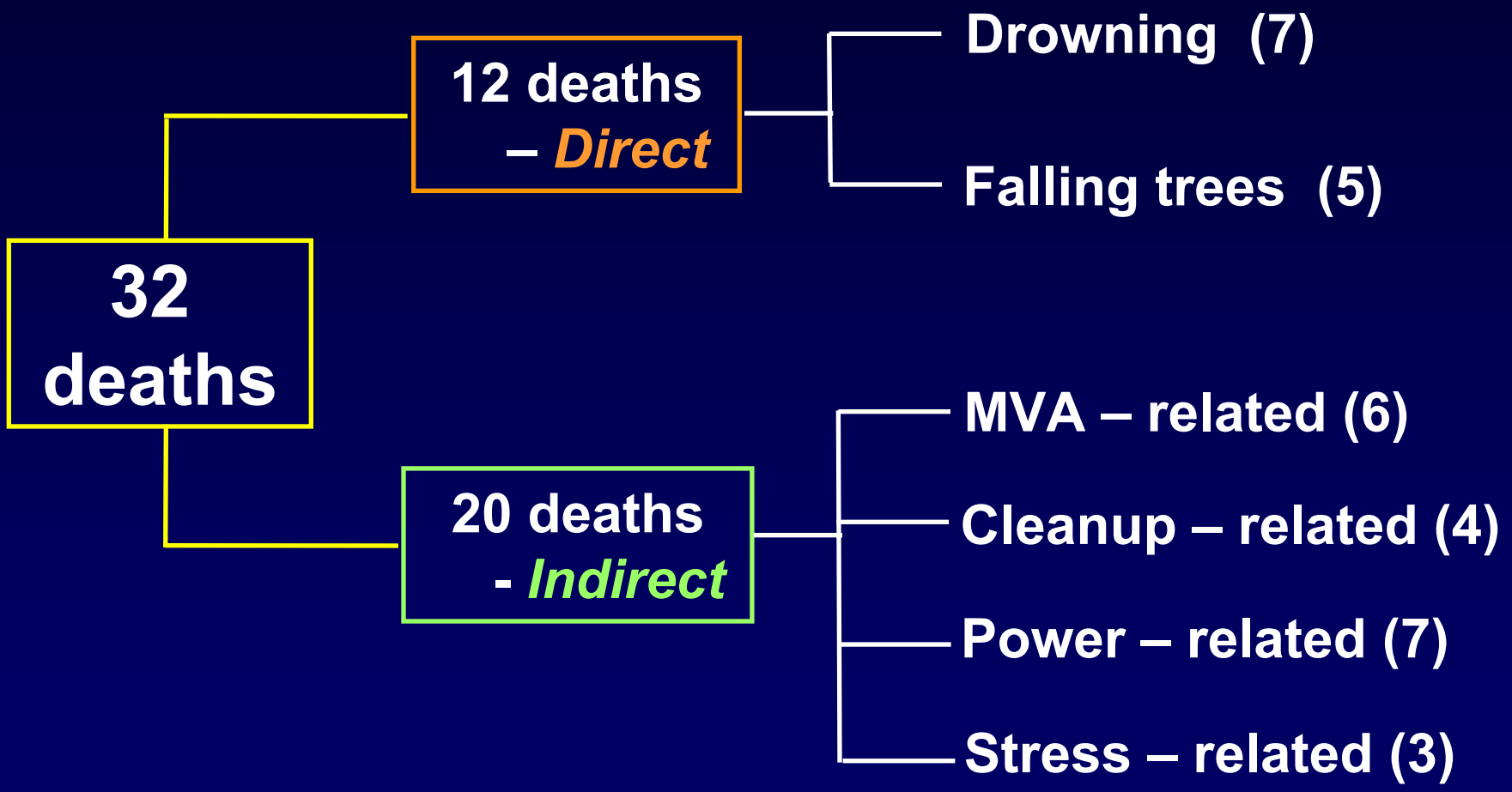
Classification of Hurricane Deaths



Classification of Hurricane Deaths



Classification of Hurricane Deaths



Causes of Death

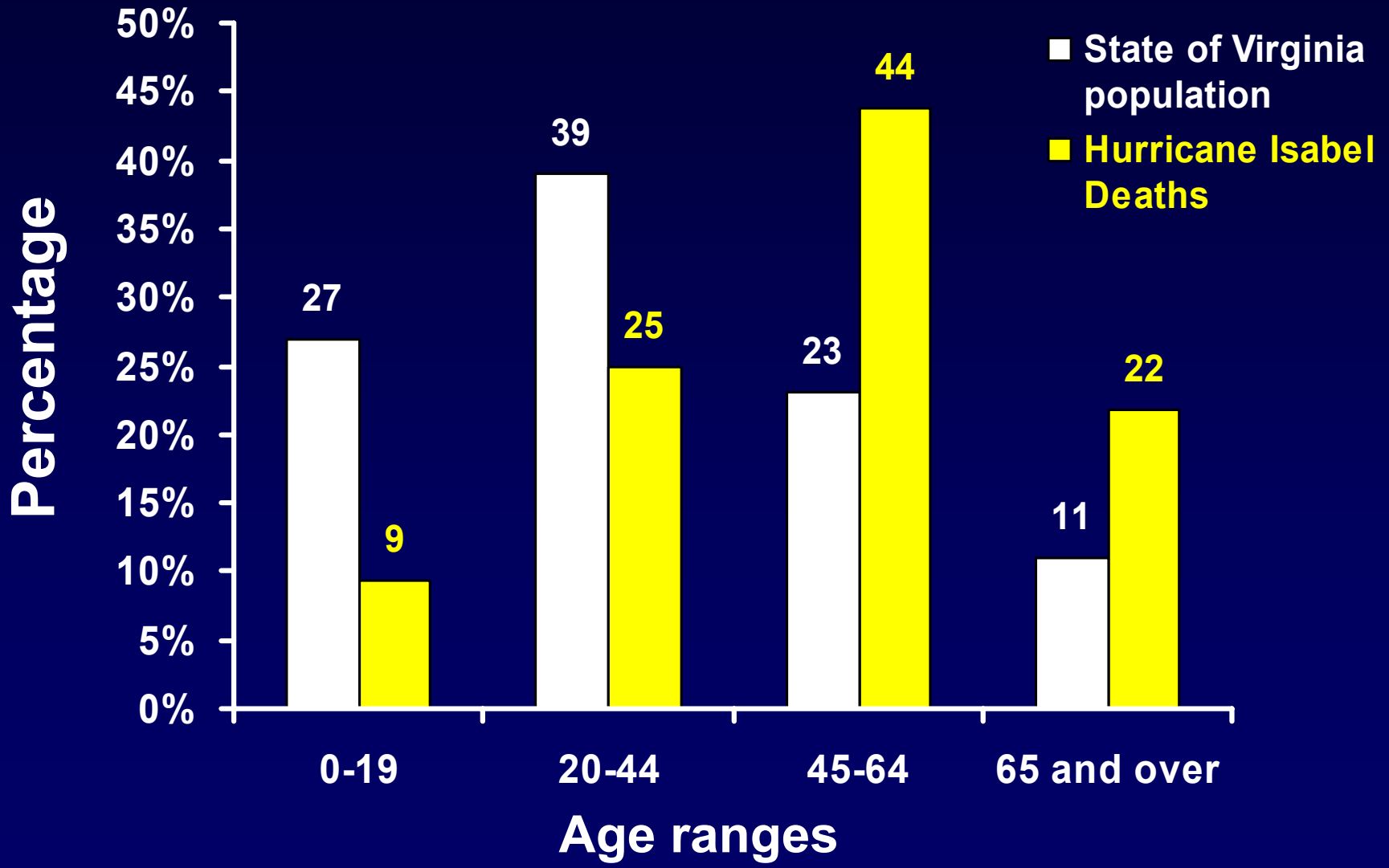
(N = 32)

Cause of Death	N	(%)
Drowning	7	(22)
MVA	6	(19)
Falling trees	5	(16)
Clean-up accident	4	(13)
CO poisoning	4	(13)
Heart attack	2	(6)
Falls	2	(6)
Burns	1	(3)
Suicide	1	(3)

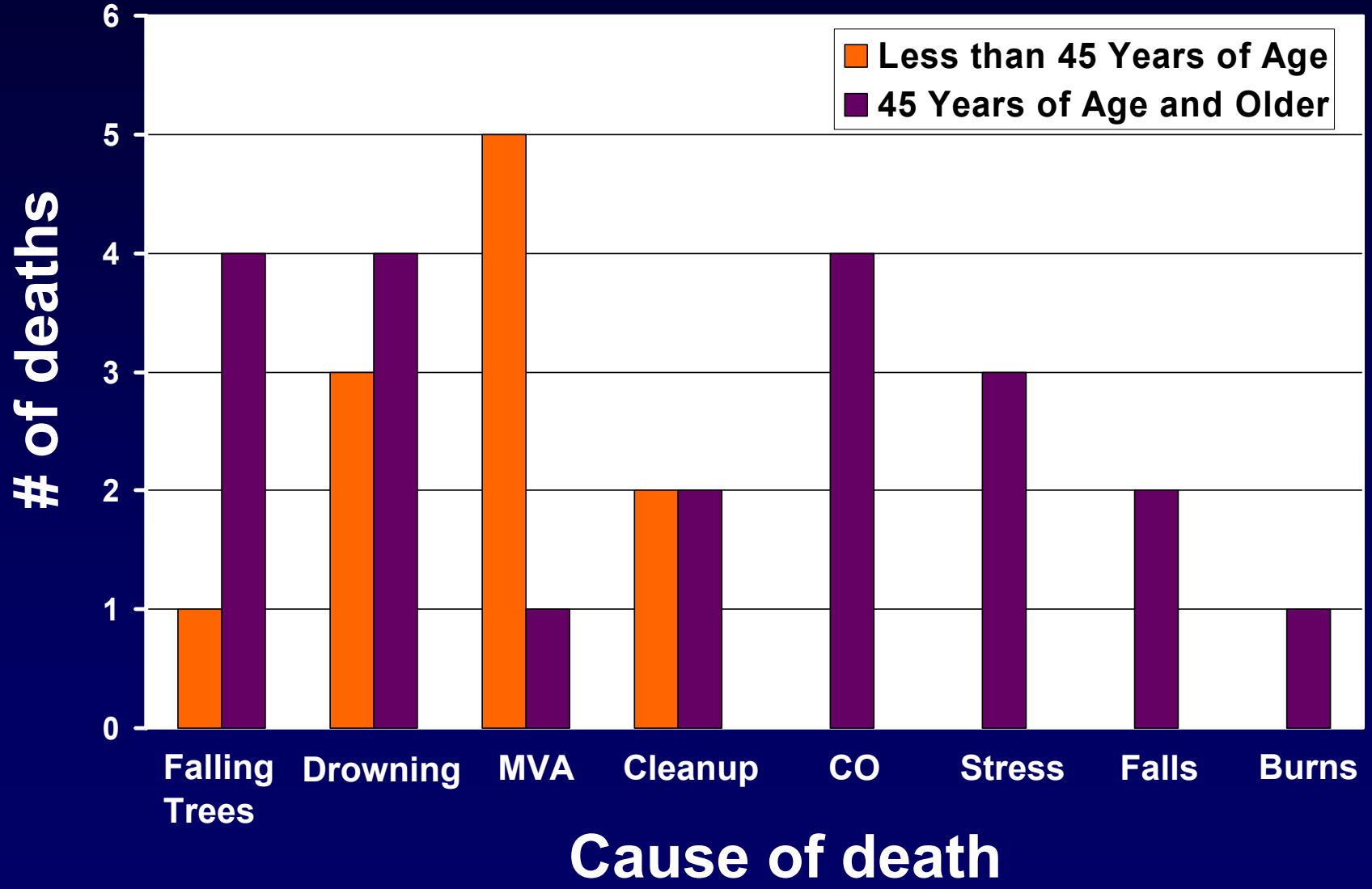
Demographics

Characteristic	n (%)
Male	24 (75)
Race	
White	20 (63)
Black	11 (34)
Asian	1 (3)
Median age (range)	48 years (7-85)
Median level of education for adults (range)	12 years (6-17)

Percentage of Population by Age Distribution (n =32)



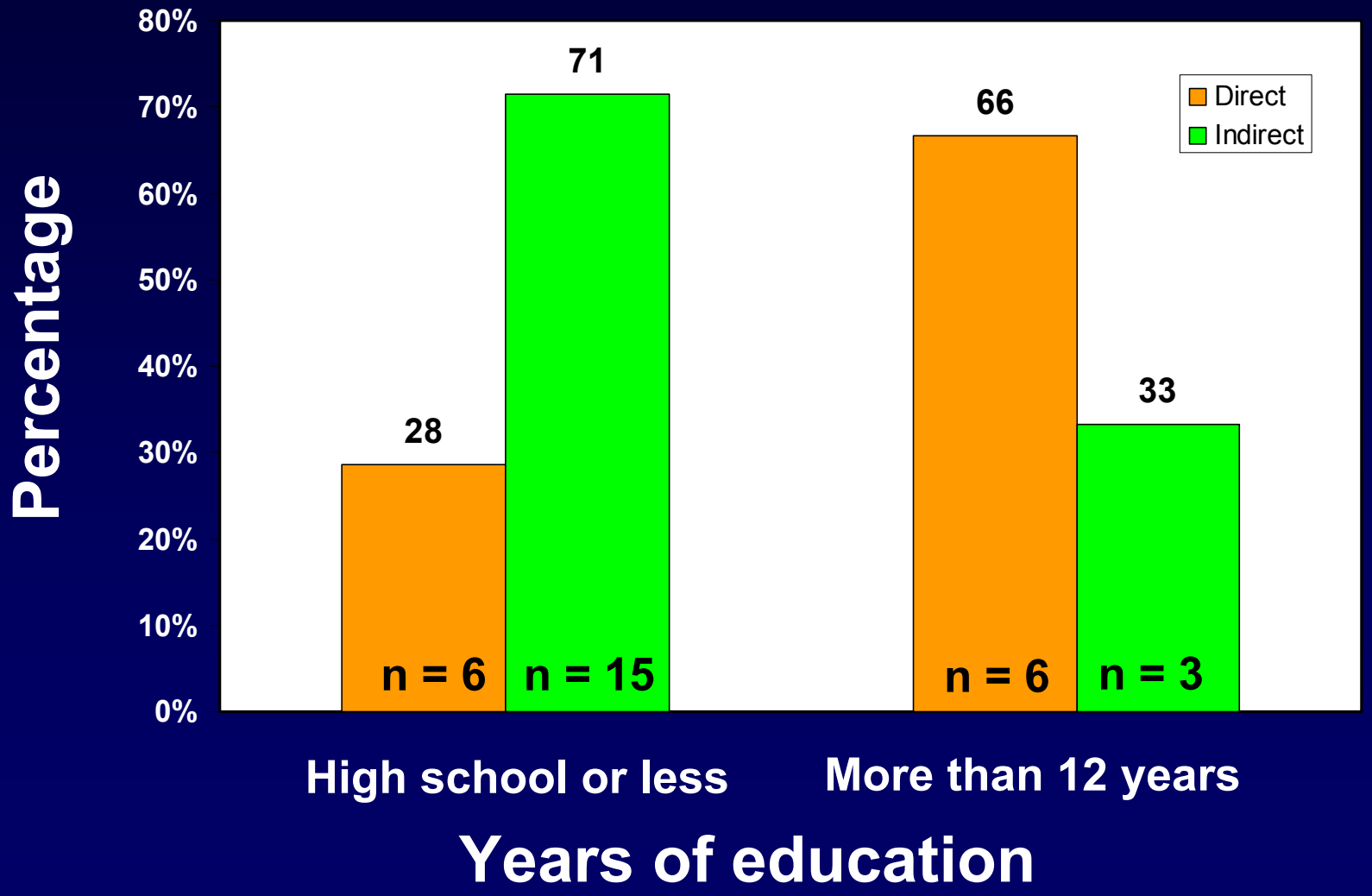
Number of Decedents by Age and Cause of Death



Location of Fatal injuries

Characteristic	n (%)
Location of injury	
Residence	16 (50)
Work	3 (9)
Other	13 (41)
Geographic area	
Urban	18 (56)
Other	14 (44)

Prevalence of Years of Education by Death Classification



Role of Intoxicants

- Present in 9 / 32 (28%) decedents
  - 8 alcohol, 1 cocaine / marijuana metabolite
- 8 males
- Median age 38 years
- Deaths during activities requiring coordination and judgment
- All died on day of injury
- Direct (4) ; indirect (5)

Impact on Mortality

- Unintentional injury deaths (UIDs)
- ICD-10 classification schema
  - Accidents - V01-X59,Y85-Y86
- UIDs on September 18 & 19, 2003
- 2003 data compared to population mortality data during same timeframe (2 dates) in prior years

Proportional Mortality

September 18 & 19

$$\frac{\text{19 deaths (hurricane related UIDs)}}{\text{29 deaths (UIDs)}}$$

0.66 x 100% = 66%

Attributable Risk

$$\frac{\text{Total \# UIDs on Sept 18-19, 2003}}{\text{Total popn (Virginia census, 2002)}} = I_E \quad \text{(Exposed)}$$

$$\frac{\text{Pooled total \# UIDs on Sept 18-19, 2000 through 2002}}{\text{Total popn Virginia (Virginia census, 2002 and 2000)}} = I_0 \quad \text{(Unexposed)}$$

Attributable Risk Percentage

$$\left[(I_E - I_0) / I_E \right] \times (100\%)$$

$$= (3.9 - 1.7) / (3.9)^{*} \times 100$$

$$= 56.4\ \%$$

* (calculations based on 10^{-6})

Attributable Risk Percentage

- 56.4% of 29 unintentional injury deaths on Sept. 18-19, 2003 or ~ 16 deaths would have potentially been averted if there had not been a hurricane
- In fact there were 19 deaths independently related to the hurricane

Limitations (Descriptive Epidemiology)

- Different case definitions could yield different results - case ascertainment issues
- Bias
  - Death certificate data limited; no proxy information available
  - Different sources of information
  - Differing time periods for hurricane related injury / death surveillance

Limitations (Quantification of Impact)

- Historical sampling
  - short time periods used in non-Hurricane years
  - matched by dates not days
- Determination of specifically exposed populations could not be made

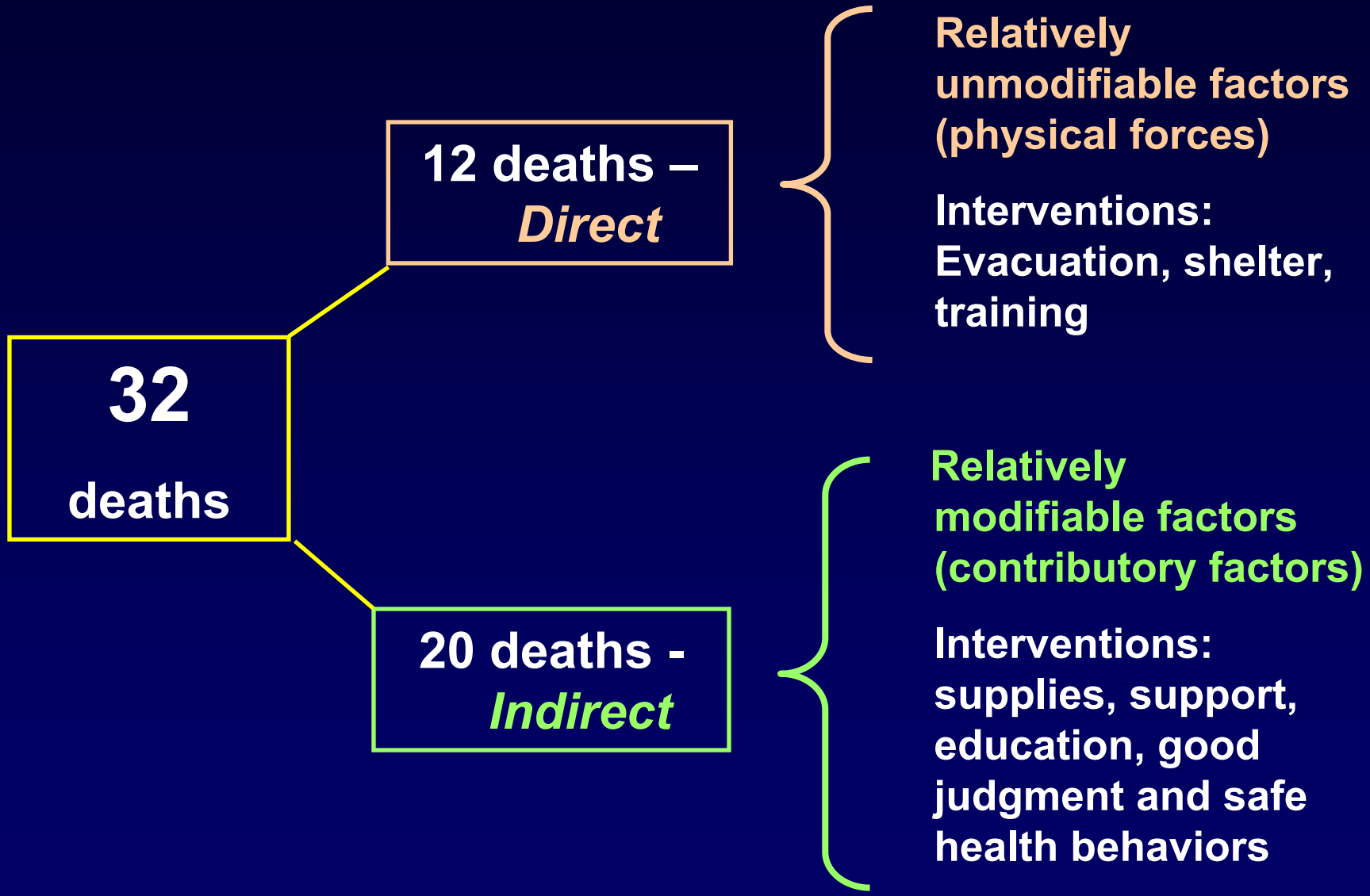
Summary of Epidemiologic Findings

- Deaths followed general track of hurricane – suggestive of highest wind / rain effects
- Population dense regions with highest death rates
- Disproportionate mortality among those over 45 years of age

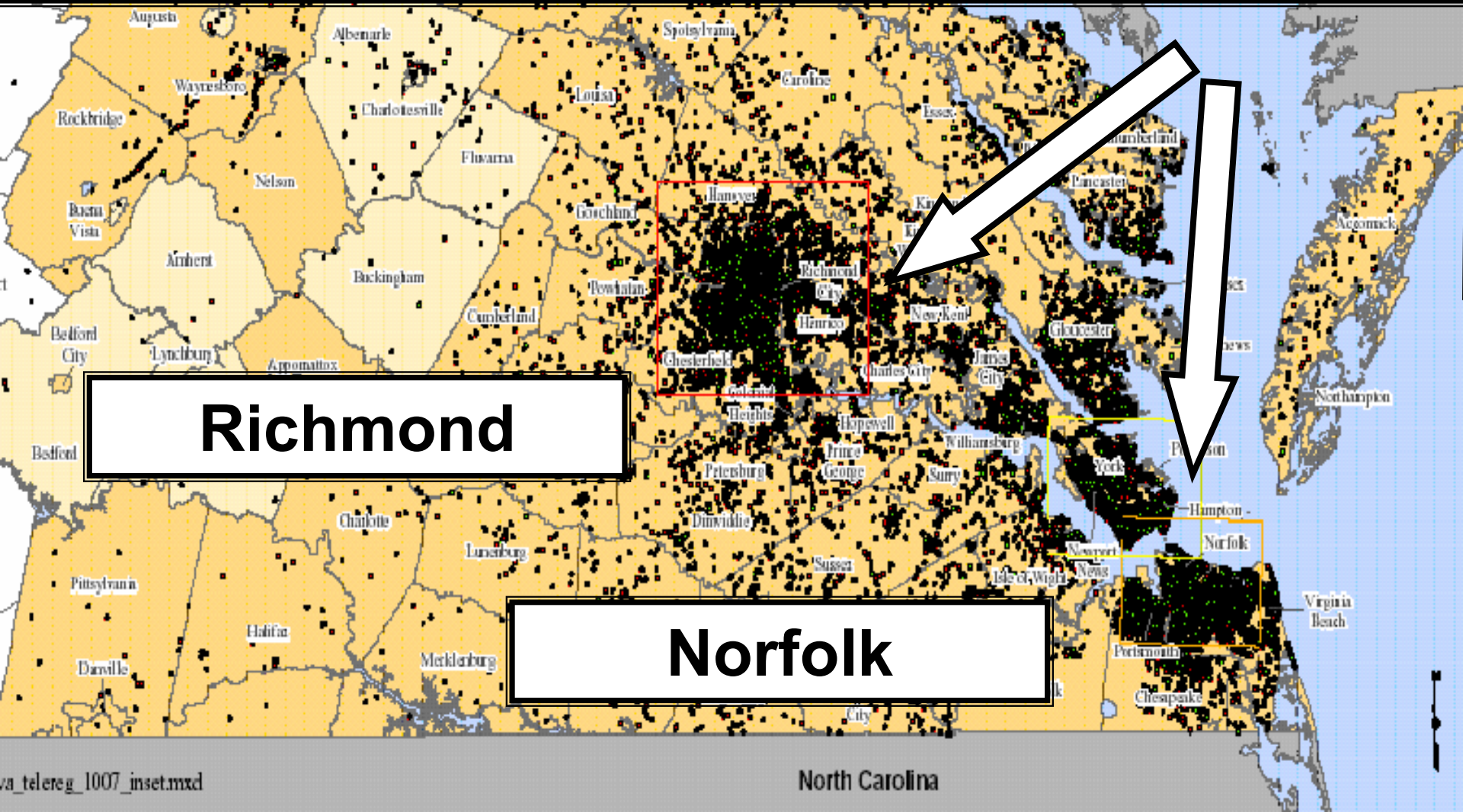
Summary of Epidemiologic Findings

- Most deaths immediate after injury
- Role of alcohol / intoxicants may be underestimated in hurricane injuries / deaths
- Quantifying impact of hurricanes feasible but *caveats* remain

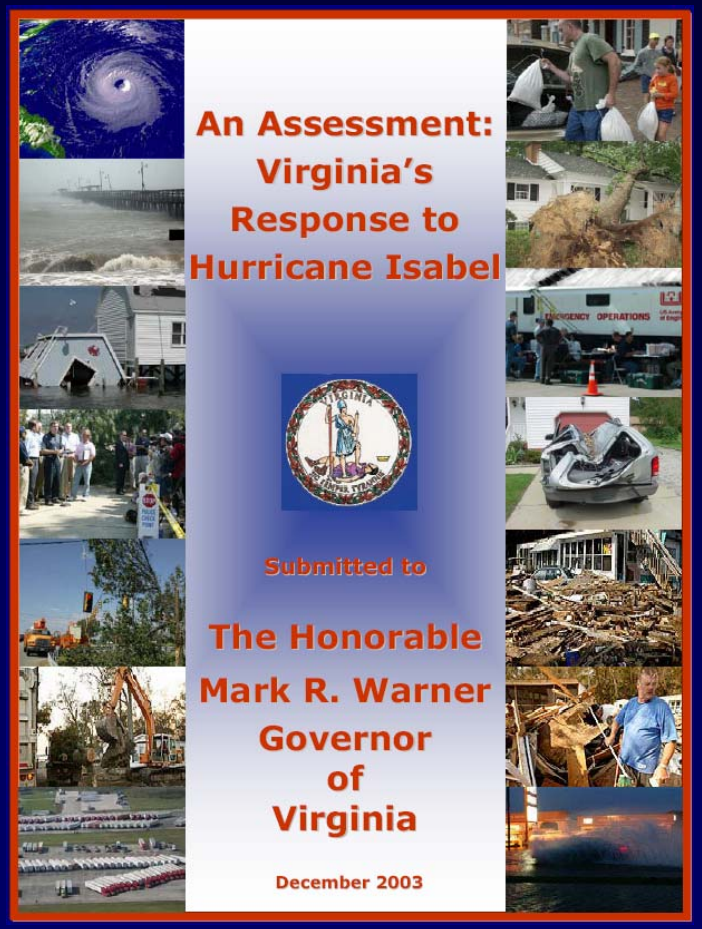
Classification Based Interventions



Entities (business / individual) Requesting Federal Assistance (10/07/03)



Virginia's Response
(Governor's Isabel Assessment Report)



- Review of Emergency Operations Plan
- Education & competency standards
- Databases; protocols; forms & procedures
- Disaster reservists' training & availability
- Financial incentive program

Virginia Department of Health Response to Hurricane Isabel

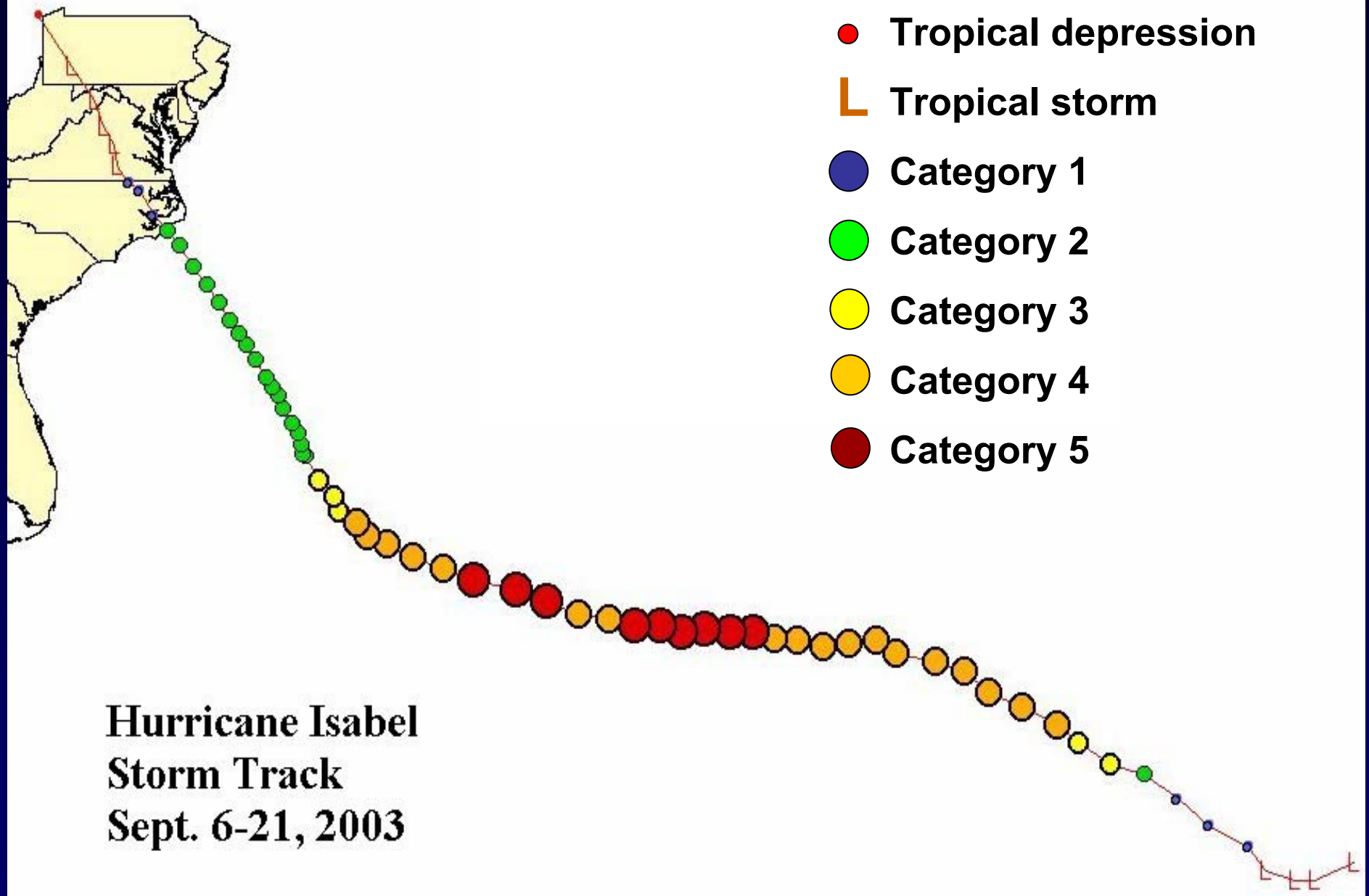
- Virginia Emergency Operations Center
  - Collaboration through Incident Command Center
  - Role of Virginia Joint Information Center (VJIC)
  - Coordination and prioritization of efforts
  - Quality improvement measures

Virginia Department of Health Response to Hurricane Isabel

- Areas of focus:
  - Public shelters
  - Electrical power resources
  - Food & water
  - Durable medical supplies (oxygen)
  - Hospitals
  - Nursing homes

Lessons Learned

- Further research on case ascertainment for fatal injuries in natural disasters
- Direct vs indirect death classification useful for prioritizing public health interventions
- Comparison potentially helpful to quantify impact of natural disasters on mortality
- Prevention education to reduce frequency and severity of unintentional injuries


Tropical depression
Tropical storm
Category 1
Category 2
Category 3
Category 4
Category 5
Hurricane Isabel
Storm Track
Sept. 6-21, 2003

Recommendations

- Provide findings to “Lessons Learned Health Directors Review Panel”
- Incorporate analytic results and conclusions into sound bytes for local media
- Improve coordination and communication between stakeholders

Acknowledgments

- Chief Medical Examiner's Office - Virginia
  - Dr. MF Fierro, Chief ME and R. Altholz, State Administrator
- Vital Statistics office – C. Reynolds
- FEMA – GIS-Tech Services Branch, VA
- National Oceanic and Atmospheric Administration ~ S. Kiser (National Hurricane Center, D.C.)
- Virginia Department of Health
- Medical College of Virginia
- Virginia law enforcement agencies
- CDC – EPO/DAPHT (State Branch) & NCEH

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Centers for Disease Control and Prevention

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